Assignment 4

July 20, 2019

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*You are currently looking at **version 1.1** of this notebook. To download notebooks and datafiles, as well as get help on Jupyter notebooks in the Coursera platform, visit the Jupyter Notebook FAQ course resource.*

```
In [6]: import pandas as pd
        import numpy as np
        from scipy.stats import ttest_ind
```

1 Assignment 4 - Hypothesis Testing

This assignment requires more individual learning than previous assignments - you are encouraged to check out the pandas documentation to find functions or methods you might not have used yet, or ask questions on Stack Overflow and tag them as pandas and python related. And of course, the discussion forums are open for interaction with your peers and the course staff.

Definitions: * A *quarter* is a specific three month period, Q1 is January through March, Q2 is April through June, Q3 is July through September, Q4 is October through December. * A *recession* is defined as starting with two consecutive quarters of GDP decline, and ending with two consecutive quarters of GDP growth. * A *recession bottom* is the quarter within a recession which had the lowest GDP. * A *university town* is a city which has a high percentage of university students compared to the total population of the city.

Hypothesis: University towns have their mean housing prices less effected by recessions. Run a t-test to compare the ratio of the mean price of houses in university towns the quarter before the recession starts compared to the recession bottom. (`price_ratio=quarter_before_recession/recession_bottom`)

The following data files are available for this assignment: * From the Zillow research data site there is housing data for the United States. In particular the datafile for all homes at a city level, `City_Zhvi_AllHomes.csv`, has median home sale prices at a fine grained level. * From the Wikipedia page on college towns is a list of university towns in the United States which has been copy and pasted into the file `university_towns.txt`. * From Bureau of Economic Analysis, US Department of Commerce, the GDP over time of the United States in current dollars (use the chained value in 2009 dollars), in quarterly intervals, in the file `gdplev.xls`. For this assignment, only look at GDP data from the first quarter of 2000 onward.

Each function in this assignment below is worth 10%, with the exception of `run_ttest()`, which is worth 50%.

In [7]:
```
# Use this dictionary to map state names to two letter acronyms
states = {'OH': 'Ohio', 'KY': 'Kentucky', 'AS': 'American Samoa', 'NV': 'Nevada', 'WY':
```

In [8]:
```
def get_list_of_university_towns():
    '''Returns a DataFrame of towns and the states they are in from the
    university_towns.txt list. The format of the DataFrame should be:
    DataFrame( [ ["Michigan", "Ann Arbor"], ["Michigan", "Yipsilanti"] ],
    columns=["State", "RegionName"]  )

    The following cleaning needs to be done:

    1. For "State", removing characters from "[" to the end.
    2. For "RegionName", when applicable, removing every character from " (" to the end.
    3. Depending on how you read the data, you may need to remove newline character '\n'
    uni_towns=pd.read_table("university_towns.txt",header=None)
    uni_towns.columns=['RegionName']
    uni_towns['RegionName']=uni_towns['RegionName'].str.split('\[').str[0]

    fun=lambda x : x if x in states.values() else np.nan
    uni_towns['State']=uni_towns['RegionName'].apply(fun)
    uni_towns['RegionName']=uni_towns['RegionName'].str.split('\s\(').str[0]
    uni_towns['State'].ffill(axis=0,inplace=True)
    uni_towns=uni_towns[uni_towns['RegionName']!=uni_towns['State']]
    uni_towns= uni_towns[['State','RegionName']]
    return uni_towns

get_list_of_university_towns()
```

Out[8]:

	State	RegionName
1	Alabama	Auburn
2	Alabama	Florence
3	Alabama	Jacksonville
4	Alabama	Livingston
5	Alabama	Montevallo
6	Alabama	Troy
7	Alabama	Tuscaloosa
8	Alabama	Tuskegee
10	Alaska	Fairbanks
12	Arizona	Flagstaff
13	Arizona	Tempe
14	Arizona	Tucson
16	Arkansas	Arkadelphia
17	Arkansas	Conway
18	Arkansas	Fayetteville
19	Arkansas	Jonesboro
20	Arkansas	Magnolia
21	Arkansas	Monticello
22	Arkansas	Russellville

```
23        Arkansas                        Searcy
25      California                        Angwin
26      California                        Arcata
27      California                      Berkeley
28      California                         Chico
29      California                      Claremont
30      California                        Cotati
31      California                         Davis
32      California                        Irvine
33      California                    Isla Vista
34      California  University Park, Los Angeles
..             ...                           ...
533       Virginia                          Wise
534       Virginia                    Chesapeake
536     Washington                    Bellingham
537     Washington                        Cheney
538     Washington                    Ellensburg
539     Washington                       Pullman
540     Washington  University District, Seattle
542  West Virginia                        Athens
543  West Virginia                     Buckhannon
544  West Virginia                       Fairmont
545  West Virginia                      Glenville
546  West Virginia                     Huntington
547  West Virginia                     Montgomery
548  West Virginia                     Morgantown
549  West Virginia                  Shepherdstown
550  West Virginia                   West Liberty
552      Wisconsin                        Appleton
553      Wisconsin                      Eau Claire
554      Wisconsin                      Green Bay
555      Wisconsin                      La Crosse
556      Wisconsin                        Madison
557      Wisconsin                      Menomonie
558      Wisconsin                      Milwaukee
559      Wisconsin                        Oshkosh
560      Wisconsin                     Platteville
561      Wisconsin                     River Falls
562      Wisconsin                  Stevens Point
563      Wisconsin                        Waukesha
564      Wisconsin                     Whitewater
566        Wyoming                        Laramie

[517 rows x 2 columns]
```

In [9]:
```
#     cleaning data
gdp=pd.read_excel("gdplev.xls",skiprows=7)
gdp.columns=['Year','Annual GDP in billions of current dollars','Annual GDP in billions
```

```
        gdp=gdp.drop(['NaN','None'],axis=1)

        #     Seleting quarters after 2000
        gdp=gdp[gdp['Quarters']>='2000q1']

        def get_recession_start():
            '''Returns the year and quarter of the recession start time as a
            string value in a format such as 2005q3'''
            for i in range(0,len(gdp)-1):
                if (gdp['Quarterly GDP in billions of chained 2009 dollars'].iloc[i]>gdp['Quarte
                    return gdp['Quarters'].iloc[i]

        get_recession_start()
```

Out[9]: '2008q3'

```
In [10]: def get_recession_end():
             '''Returns the year and quarter of the recession end time as a
             string value in a format such as 2005q3'''
             start=get_recession_start()
         #     start after recession quarter
             gdp1=gdp[gdp['Quarters']>=start]

             for i in range(0,len(gdp1)):
                 if (gdp1['Quarterly GDP in billions of chained 2009 dollars'].iloc[i]<gdp1['Qua
                     return gdp1['Quarters'].iloc[i+2]
         get_recession_end()
```

Out[10]: '2009q4'

```
In [11]: def get_recession_bottom():
             '''Returns the year and quarter of the recession bottom time as a
             string value in a format such as 2005q3'''
             start=get_recession_start()
             end=get_recession_end()

             return gdp[(gdp['Quarters']>=start)&(gdp['Quarters']<=end)].sort_values(by='Quarter
         get_recession_bottom()
```

Out[11]: '2009q2'

```
In [13]: def convert_housing_data_to_quarters():
             '''Converts the housing data to quarters and returns it as mean
             values in a dataframe. This dataframe should be a dataframe with
         #     columns for 2000q1 through 2016q3, and should have a multi-index
         #     in the shape of ["State","RegionName"].

         #     Note: Quarters are defined in the assignment description, they are
         #     not arbitrary three month periods.
```

```
#     The resulting dataframe should have 67 columns, and 10,730 rows.
    '''
    homes=pd.read_csv('City_Zhvi_AllHomes.csv')
    new=homes.drop(['Metro','CountyName','RegionID','SizeRank','RegionName','State'],ax

    for k,i in enumerate(new.columns):
        j=i.split('-')
        if j[1]=='01':
                col_name=j[0]+'q1'
                new[col_name]=new[[k,k+1,k+2]].mean(axis=1,skipna=True)
        if j[1]=='04':
                col_name=j[0]+'q2'
                new[col_name]=new[[k,k+1,k+2]].mean(axis=1)
        if j[1]=='07':
                col_name=j[0]+'q3'
                new[col_name]=new[[k,k+1,k+2]].mean(axis=1)
        if j[1]=='10':
                col_name=j[0]+'q4'
                new[col_name]=new[[k,k+1,k+2]].mean(axis=1)

    new= new[new.columns[-67:]]
    final= pd.concat([homes[['State','RegionName']],new],axis=1)
    final['State']=final['State'].map(states)
    final.set_index(['State','RegionName'],inplace=True)
    return final
# check below 1 line sol
#    housingdata_df = housingdata_df.groupby(pd.PeriodIndex(housingdata_df.columns, fre
convert_housing_data_to_quarters()
```

Out[13]:

State	RegionName	2000q1	2000q2	\
New York	New York	NaN	NaN	
California	Los Angeles	2.070667e+05	2.144667e+05	
Illinois	Chicago	1.384000e+05	1.436333e+05	
Pennsylvania	Philadelphia	5.300000e+04	5.363333e+04	
Arizona	Phoenix	1.118333e+05	1.143667e+05	
Nevada	Las Vegas	1.326000e+05	1.343667e+05	
California	San Diego	2.229000e+05	2.343667e+05	
Texas	Dallas	8.446667e+04	8.386667e+04	
California	San Jose	3.742667e+05	4.065667e+05	
Florida	Jacksonville	8.860000e+04	8.970000e+04	
California	San Francisco	4.305000e+05	4.644667e+05	
Texas	Austin	1.429667e+05	1.452667e+05	
Michigan	Detroit	6.616667e+04	6.830000e+04	
Ohio	Columbus	9.436667e+04	9.583333e+04	
Tennessee	Memphis	7.250000e+04	7.320000e+04	
North Carolina	Charlotte	1.269333e+05	1.283667e+05	

```
Texas                El Paso              7.626667e+04  7.686667e+04
Massachusetts        Boston               2.069333e+05  2.191667e+05
Washington           Seattle              2.486000e+05  2.556000e+05
Maryland             Baltimore            5.966667e+04  5.950000e+04
Colorado             Denver               1.622333e+05  1.678333e+05
District of Columbia Washington           1.377667e+05  1.442000e+05
Tennessee            Nashville            1.138333e+05  1.152667e+05
Wisconsin            Milwaukee            7.803333e+04  7.906667e+04
Arizona              Tucson               1.018333e+05  1.029667e+05
Oregon               Portland             1.528000e+05  1.547667e+05
Oklahoma             Oklahoma City        7.643333e+04  7.750000e+04
Nebraska             Omaha                1.128000e+05  1.141000e+05
New Mexico           Albuquerque          1.258667e+05  1.267000e+05
California           Fresno               9.410000e+04  9.526667e+04
...                                             ...           ...
Texas                Granite Shoals              NaN           NaN
Maryland             Piney Point          1.556667e+05  1.551667e+05
Wisconsin            Maribel                     NaN           NaN
Idaho                Middleton            1.060667e+05  1.043333e+05
Colorado             Bennett              1.329000e+05  1.358333e+05
New Hampshire        East Hampstead       1.618333e+05  1.691000e+05
Missouri             Garden City                 NaN           NaN
Arkansas             Mountainburg         5.716667e+04  6.433333e+04
Wisconsin            Oostburg             1.072667e+05  1.081000e+05
California           Twin Peaks           9.736667e+04  1.001667e+05
New York             Upper Brookville     1.230967e+06  1.230967e+06
Hawaii               Volcano              9.870000e+04  1.053667e+05
South Carolina       Wedgefield                  NaN           NaN
Michigan             Williamston          1.591667e+05  1.613000e+05
Arkansas             Decatur              6.360000e+04  6.440000e+04
Tennessee            Briceville           4.000000e+04  4.173333e+04
Indiana              Edgewood             9.170000e+04  9.186667e+04
Tennessee            Palmyra                     NaN           NaN
Maryland             Saint Inigoes        1.480667e+05  1.476000e+05
Indiana              Marysville                  NaN           NaN
California           Forest Falls         1.135333e+05  1.144000e+05
Missouri             Bois D Arc           1.078000e+05  1.069667e+05
Virginia             Henrico              1.285667e+05  1.307667e+05
New Jersey           Diamond Beach        1.739667e+05  1.831000e+05
Tennessee            Gruetli Laager       3.540000e+04  3.546667e+04
Wisconsin            Town of Wrightstown  1.017667e+05  1.054000e+05
New York             Urbana               7.920000e+04  8.166667e+04
Wisconsin            New Denmark          1.145667e+05  1.192667e+05
California           Angels               1.510000e+05  1.559000e+05
Wisconsin            Holland              1.510333e+05  1.505000e+05

                                               2000q3        2000q4  \
State                RegionName
```

New York	New York	NaN	NaN
California	Los Angeles	2.209667e+05	2.261667e+05
Illinois	Chicago	1.478667e+05	1.521333e+05
Pennsylvania	Philadelphia	5.413333e+04	5.470000e+04
Arizona	Phoenix	1.160000e+05	1.174000e+05
Nevada	Las Vegas	1.354000e+05	1.370000e+05
California	San Diego	2.454333e+05	2.560333e+05
Texas	Dallas	8.486667e+04	8.783333e+04
California	San Jose	4.318667e+05	4.555000e+05
Florida	Jacksonville	9.170000e+04	9.310000e+04
California	San Francisco	4.835333e+05	4.930000e+05
Texas	Austin	1.494667e+05	1.557333e+05
Michigan	Detroit	6.676667e+04	6.703333e+04
Ohio	Columbus	9.713333e+04	9.826667e+04
Tennessee	Memphis	7.386667e+04	7.400000e+04
North Carolina	Charlotte	1.302000e+05	1.315667e+05
Texas	El Paso	7.673333e+04	7.730000e+04
Massachusetts	Boston	2.331000e+05	2.425000e+05
Washington	Seattle	2.625333e+05	2.674000e+05
Maryland	Baltimore	5.883333e+04	5.950000e+04
Colorado	Denver	1.743333e+05	1.803333e+05
District of Columbia	Washington	1.487000e+05	1.477000e+05
Tennessee	Nashville	1.158667e+05	1.169333e+05
Wisconsin	Milwaukee	8.103333e+04	8.233333e+04
Arizona	Tucson	1.044667e+05	1.056667e+05
Oregon	Portland	1.565667e+05	1.574667e+05
Oklahoma	Oklahoma City	7.856667e+04	7.916667e+04
Nebraska	Omaha	1.167333e+05	1.189000e+05
New Mexico	Albuquerque	1.264333e+05	1.267333e+05
California	Fresno	9.646667e+04	9.823333e+04
...		...	...
Texas	Granite Shoals	NaN	NaN
Maryland	Piney Point	1.584667e+05	1.637000e+05
Wisconsin	Maribel	NaN	NaN
Idaho	Middleton	1.019000e+05	1.041667e+05
Colorado	Bennett	1.398000e+05	1.446667e+05
New Hampshire	East Hampstead	1.739667e+05	1.805000e+05
Missouri	Garden City	NaN	NaN
Arkansas	Mountainburg	6.783333e+04	6.900000e+04
Wisconsin	Oostburg	1.124333e+05	1.155000e+05
California	Twin Peaks	1.013333e+05	1.017000e+05
New York	Upper Brookville	1.237700e+06	1.261567e+06
Hawaii	Volcano	1.146667e+05	1.247667e+05
South Carolina	Wedgefield	NaN	NaN
Michigan	Williamston	1.643000e+05	1.662000e+05
Arkansas	Decatur	6.566667e+04	6.673333e+04
Tennessee	Briceville	4.366667e+04	4.490000e+04
Indiana	Edgewood	9.293333e+04	9.490000e+04

Tennessee	Palmyra	NaN	NaN
Maryland	Saint Inigoes	1.572333e+05	1.633667e+05
Indiana	Marysville	NaN	NaN
California	Forest Falls	1.141667e+05	1.111333e+05
Missouri	Bois D Arc	1.071000e+05	1.081000e+05
Virginia	Henrico	1.322667e+05	1.332667e+05
New Jersey	Diamond Beach	1.889667e+05	1.931333e+05
Tennessee	Gruetli Laager	3.666667e+04	3.730000e+04
Wisconsin	Town of Wrightstown	1.113667e+05	1.148667e+05
New York	Urbana	9.170000e+04	9.836667e+04
Wisconsin	New Denmark	1.260667e+05	1.319667e+05
California	Angels	1.581000e+05	1.674667e+05
Wisconsin	Holland	1.532333e+05	1.558333e+05

		2001q1	2001q2	\
State	RegionName			
New York	New York	NaN	NaN	
California	Los Angeles	2.330000e+05	2.391000e+05	
Illinois	Chicago	1.569333e+05	1.618000e+05	
Pennsylvania	Philadelphia	5.533333e+04	5.553333e+04	
Arizona	Phoenix	1.196000e+05	1.215667e+05	
Nevada	Las Vegas	1.395333e+05	1.417333e+05	
California	San Diego	2.672000e+05	2.762667e+05	
Texas	Dallas	8.973333e+04	8.930000e+04	
California	San Jose	4.706667e+05	4.702000e+05	
Florida	Jacksonville	9.440000e+04	9.560000e+04	
California	San Francisco	4.940667e+05	4.961333e+05	
Texas	Austin	1.612333e+05	1.607333e+05	
Michigan	Detroit	6.750000e+04	6.836667e+04	
Ohio	Columbus	9.940000e+04	1.002667e+05	
Tennessee	Memphis	7.416667e+04	7.493333e+04	
North Carolina	Charlotte	1.329333e+05	1.332000e+05	
Texas	El Paso	7.823333e+04	7.830000e+04	
Massachusetts	Boston	2.496000e+05	2.570667e+05	
Washington	Seattle	2.710000e+05	2.724333e+05	
Maryland	Baltimore	5.956667e+04	6.013333e+04	
Colorado	Denver	1.865000e+05	1.925333e+05	
District of Columbia	Washington	1.497667e+05	1.551333e+05	
Tennessee	Nashville	1.180333e+05	1.191667e+05	
Wisconsin	Milwaukee	8.403333e+04	8.556667e+04	
Arizona	Tucson	1.072000e+05	1.087667e+05	
Oregon	Portland	1.599000e+05	1.618000e+05	
Oklahoma	Oklahoma City	7.983333e+04	8.040000e+04	
Nebraska	Omaha	1.208667e+05	1.197667e+05	
New Mexico	Albuquerque	1.271000e+05	1.277333e+05	
California	Fresno	1.005667e+05	1.035667e+05	
...		...	...	
Texas	Granite Shoals	NaN	NaN	

Maryland	Piney Point	1.634000e+05	1.648333e+05
Wisconsin	Maribel	NaN	NaN
Idaho	Middleton	1.061667e+05	1.083667e+05
Colorado	Bennett	1.483000e+05	1.521000e+05
New Hampshire	East Hampstead	1.909000e+05	1.950667e+05
Missouri	Garden City	NaN	NaN
Arkansas	Mountainburg	6.866667e+04	6.386667e+04
Wisconsin	Oostburg	1.191000e+05	1.204333e+05
California	Twin Peaks	1.040000e+05	1.076667e+05
New York	Upper Brookville	1.295167e+06	1.340033e+06
Hawaii	Volcano	1.181333e+05	1.194000e+05
South Carolina	Wedgefield	NaN	NaN
Michigan	Williamston	1.664333e+05	1.686333e+05
Arkansas	Decatur	6.720000e+04	6.770000e+04
Tennessee	Briceville	4.480000e+04	4.530000e+04
Indiana	Edgewood	9.893333e+04	1.000667e+05
Tennessee	Palmyra	NaN	NaN
Maryland	Saint Inigoes	1.642333e+05	1.682000e+05
Indiana	Marysville	NaN	NaN
California	Forest Falls	1.134333e+05	1.130000e+05
Missouri	Bois D Arc	1.107000e+05	1.136667e+05
Virginia	Henrico	1.352333e+05	1.367333e+05
New Jersey	Diamond Beach	1.944000e+05	2.102667e+05
Tennessee	Gruetli Laager	3.773333e+04	3.790000e+04
Wisconsin	Town of Wrightstown	1.259667e+05	1.299000e+05
New York	Urbana	9.486667e+04	9.853333e+04
Wisconsin	New Denmark	1.438000e+05	1.469667e+05
California	Angels	1.768333e+05	1.837667e+05
Wisconsin	Holland	1.618667e+05	1.657333e+05

		2001q3	2001q4	\
State	RegionName			
New York	New York	NaN	NaN	
California	Los Angeles	2.450667e+05	2.530333e+05	
Illinois	Chicago	1.664000e+05	1.704333e+05	
Pennsylvania	Philadelphia	5.626667e+04	5.753333e+04	
Arizona	Phoenix	1.227000e+05	1.243000e+05	
Nevada	Las Vegas	1.433667e+05	1.461333e+05	
California	San Diego	2.845000e+05	2.919333e+05	
Texas	Dallas	8.906667e+04	9.090000e+04	
California	San Jose	4.568000e+05	4.455667e+05	
Florida	Jacksonville	9.706667e+04	9.906667e+04	
California	San Francisco	5.041000e+05	5.134000e+05	
Texas	Austin	1.595333e+05	1.600333e+05	
Michigan	Detroit	6.926667e+04	6.996667e+04	
Ohio	Columbus	1.010667e+05	1.022000e+05	
Tennessee	Memphis	7.550000e+04	7.606667e+04	
North Carolina	Charlotte	1.328000e+05	1.331000e+05	

Texas	El Paso	7.743333e+04	7.680000e+04
Massachusetts	Boston	2.669333e+05	2.749667e+05
Washington	Seattle	2.741667e+05	2.781667e+05
Maryland	Baltimore	6.210000e+04	6.340000e+04
Colorado	Denver	1.964000e+05	1.991000e+05
District of Columbia	Washington	1.646333e+05	1.725333e+05
Tennessee	Nashville	1.201000e+05	1.208000e+05
Wisconsin	Milwaukee	8.706667e+04	8.840000e+04
Arizona	Tucson	1.105667e+05	1.128000e+05
Oregon	Portland	1.642667e+05	1.677667e+05
Oklahoma	Oklahoma City	8.113333e+04	8.173333e+04
Nebraska	Omaha	1.178667e+05	1.174000e+05
New Mexico	Albuquerque	1.285667e+05	1.299000e+05
California	Fresno	1.072333e+05	1.103000e+05
...		...	...
Texas	Granite Shoals	NaN	NaN
Maryland	Piney Point	1.647000e+05	1.679000e+05
Wisconsin	Maribel	NaN	NaN
Idaho	Middleton	1.110333e+05	1.112333e+05
Colorado	Bennett	1.542333e+05	1.562000e+05
New Hampshire	East Hampstead	1.992667e+05	2.074000e+05
Missouri	Garden City	NaN	NaN
Arkansas	Mountainburg	6.376667e+04	6.546667e+04
Wisconsin	Oostburg	1.203667e+05	1.196333e+05
California	Twin Peaks	1.098333e+05	1.111333e+05
New York	Upper Brookville	1.403667e+06	1.481933e+06
Hawaii	Volcano	1.232667e+05	1.211667e+05
South Carolina	Wedgefield	NaN	NaN
Michigan	Williamston	1.716667e+05	1.750333e+05
Arkansas	Decatur	6.650000e+04	6.540000e+04
Tennessee	Briceville	4.463333e+04	4.370000e+04
Indiana	Edgewood	1.008333e+05	1.010000e+05
Tennessee	Palmyra	NaN	NaN
Maryland	Saint Inigoes	1.665000e+05	1.653333e+05
Indiana	Marysville	NaN	NaN
California	Forest Falls	1.130333e+05	1.151667e+05
Missouri	Bois D Arc	1.126333e+05	1.127333e+05
Virginia	Henrico	1.386000e+05	1.413333e+05
New Jersey	Diamond Beach	2.302667e+05	2.486667e+05
Tennessee	Gruetli Laager	3.936667e+04	4.040000e+04
Wisconsin	Town of Wrightstown	1.299000e+05	1.294333e+05
New York	Urbana	1.029667e+05	9.803333e+04
Wisconsin	New Denmark	1.483667e+05	1.491667e+05
California	Angels	1.902333e+05	1.845667e+05
Wisconsin	Holland	1.680333e+05	1.674000e+05

		2002q1	2002q2	\
State	RegionName			

New York	New York	NaN	NaN
California	Los Angeles	2.619667e+05	2.727000e+05
Illinois	Chicago	1.755000e+05	1.775667e+05
Pennsylvania	Philadelphia	5.913333e+04	6.073333e+04
Arizona	Phoenix	1.265333e+05	1.283667e+05
Nevada	Las Vegas	1.493333e+05	1.509333e+05
California	San Diego	3.012333e+05	3.128667e+05
Texas	Dallas	9.256667e+04	9.380000e+04
California	San Jose	4.414333e+05	4.577667e+05
Florida	Jacksonville	1.012333e+05	1.034333e+05
California	San Francisco	5.204333e+05	5.381667e+05
Texas	Austin	1.589667e+05	1.575000e+05
Michigan	Detroit	7.100000e+04	7.233333e+04
Ohio	Columbus	1.034000e+05	1.048000e+05
Tennessee	Memphis	7.633333e+04	7.676667e+04
North Carolina	Charlotte	1.343667e+05	1.353667e+05
Texas	El Paso	7.660000e+04	7.640000e+04
Massachusetts	Boston	2.825000e+05	2.893000e+05
Washington	Seattle	2.805000e+05	2.846000e+05
Maryland	Baltimore	6.366667e+04	6.490000e+04
Colorado	Denver	2.012333e+05	2.024333e+05
District of Columbia	Washington	1.805000e+05	1.933000e+05
Tennessee	Nashville	1.215667e+05	1.226333e+05
Wisconsin	Milwaukee	8.953333e+04	9.136667e+04
Arizona	Tucson	1.150000e+05	1.172000e+05
Oregon	Portland	1.707667e+05	1.741333e+05
Oklahoma	Oklahoma City	8.260000e+04	8.343333e+04
Nebraska	Omaha	1.180667e+05	1.176333e+05
New Mexico	Albuquerque	1.310667e+05	1.321000e+05
California	Fresno	1.140333e+05	1.185333e+05
...		...	...
Texas	Granite Shoals	NaN	NaN
Maryland	Piney Point	1.782667e+05	1.812000e+05
Wisconsin	Maribel	NaN	NaN
Idaho	Middleton	1.141000e+05	1.141667e+05
Colorado	Bennett	1.587333e+05	1.606333e+05
New Hampshire	East Hampstead	2.123000e+05	2.122333e+05
Missouri	Garden City	NaN	NaN
Arkansas	Mountainburg	6.533333e+04	6.600000e+04
Wisconsin	Oostburg	1.198667e+05	1.185667e+05
California	Twin Peaks	1.132000e+05	1.166000e+05
New York	Upper Brookville	1.536167e+06	1.562033e+06
Hawaii	Volcano	1.233000e+05	1.169000e+05
South Carolina	Wedgefield	NaN	NaN
Michigan	Williamston	1.786667e+05	1.793333e+05
Arkansas	Decatur	6.460000e+04	6.490000e+04
Tennessee	Briceville	4.446667e+04	4.340000e+04
Indiana	Edgewood	1.021667e+05	1.017667e+05

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Tennessee            Palmyra                      NaN           NaN
Maryland             Saint Inigoes       1.673000e+05  1.688000e+05
Indiana              Marysville                   NaN           NaN
California           Forest Falls        1.187000e+05  1.250667e+05
Missouri             Bois D Arc          1.130667e+05  1.154000e+05
Virginia             Henrico             1.435333e+05  1.461333e+05
New Jersey           Diamond Beach       2.599333e+05  2.656333e+05
Tennessee            Gruetli Laager      4.156667e+04  4.163333e+04
Wisconsin            Town of Wrightstown 1.319000e+05  1.342000e+05
New York             Urbana              9.396667e+04  9.460000e+04
Wisconsin            New Denmark         1.531333e+05  1.567333e+05
California           Angels              1.840333e+05  1.861333e+05
Wisconsin            Holland             1.657667e+05  1.619667e+05

                                               ...           2014q2  \
State                RegionName                ...
New York             New York                  ...       5.154667e+05
California           Los Angeles               ...       4.980333e+05
Illinois             Chicago                   ...       1.926333e+05
Pennsylvania         Philadelphia              ...       1.137333e+05
Arizona              Phoenix                   ...       1.642667e+05
Nevada               Las Vegas                 ...       1.700667e+05
California           San Diego                 ...       4.802000e+05
Texas                Dallas                    ...       1.066333e+05
California           San Jose                  ...       6.794000e+05
Florida              Jacksonville              ...       1.207667e+05
California           San Francisco             ...       9.269333e+05
Texas                Austin                    ...       2.488667e+05
Michigan             Detroit                   ...       3.730000e+04
Ohio                 Columbus                  ...       1.031333e+05
Tennessee            Memphis                   ...       6.810000e+04
North Carolina       Charlotte                 ...       1.494667e+05
Texas                El Paso                   ...       1.118000e+05
Massachusetts        Boston                    ...       4.266667e+05
Washington           Seattle                   ...       4.418000e+05
Maryland             Baltimore                 ...       1.092333e+05
Colorado             Denver                    ...       2.708667e+05
District of Columbia Washington                ...       4.469333e+05
Tennessee            Nashville                 ...       1.607000e+05
Wisconsin            Milwaukee                 ...       9.216667e+04
Arizona              Tucson                    ...       1.424667e+05
Oregon               Portland                  ...       2.822333e+05
Oklahoma             Oklahoma City             ...       1.180333e+05
Nebraska             Omaha                     ...       1.301000e+05
New Mexico           Albuquerque               ...       1.632667e+05
California           Fresno                    ...       1.696333e+05
...                                            ...                ...
Texas                Granite Shoals            ...       1.169667e+05
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Maryland	Piney Point	...	2.964000e+05
Wisconsin	Maribel	...	1.306000e+05
Idaho	Middleton	...	1.443667e+05
Colorado	Bennett	...	1.514667e+05
New Hampshire	East Hampstead	...	2.495000e+05
Missouri	Garden City	...	1.055000e+05
Arkansas	Mountainburg	...	8.160000e+04
Wisconsin	Oostburg	...	1.295667e+05
California	Twin Peaks	...	1.501000e+05
New York	Upper Brookville	...	1.780633e+06
Hawaii	Volcano	...	2.064667e+05
South Carolina	Wedgefield	...	7.436667e+04
Michigan	Williamston	...	1.657000e+05
Arkansas	Decatur	...	8.966667e+04
Tennessee	Briceville	...	5.623333e+04
Indiana	Edgewood	...	9.213333e+04
Tennessee	Palmyra	...	1.227667e+05
Maryland	Saint Inigoes	...	2.822333e+05
Indiana	Marysville	...	1.166000e+05
California	Forest Falls	...	1.653667e+05
Missouri	Bois D Arc	...	1.375667e+05
Virginia	Henrico	...	2.016333e+05
New Jersey	Diamond Beach	...	3.818000e+05
Tennessee	Gruetli Laager	...	5.556667e+04
Wisconsin	Town of Wrightstown	...	1.448667e+05
New York	Urbana	...	1.321333e+05
Wisconsin	New Denmark	...	1.745667e+05
California	Angels	...	2.444667e+05
Wisconsin	Holland	...	2.012667e+05

		2014q3	2014q4	\
State	RegionName			
New York	New York	5.228000e+05	5.280667e+05	
California	Los Angeles	5.090667e+05	5.188667e+05	
Illinois	Chicago	1.957667e+05	2.012667e+05	
Pennsylvania	Philadelphia	1.153000e+05	1.156667e+05	
Arizona	Phoenix	1.653667e+05	1.685000e+05	
Nevada	Las Vegas	1.734000e+05	1.754667e+05	
California	San Diego	4.890333e+05	4.964333e+05	
Texas	Dallas	1.089000e+05	1.115333e+05	
California	San Jose	6.970333e+05	7.149333e+05	
Florida	Jacksonville	1.217333e+05	1.231667e+05	
California	San Francisco	9.545333e+05	9.687667e+05	
Texas	Austin	2.528000e+05	2.581333e+05	
Michigan	Detroit	3.710000e+04	3.713333e+04	
Ohio	Columbus	1.045000e+05	1.064333e+05	
Tennessee	Memphis	6.910000e+04	7.116667e+04	
North Carolina	Charlotte	1.506333e+05	1.527333e+05	

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Texas                El Paso              1.117333e+05  1.117667e+05
Massachusetts        Boston               4.314333e+05  4.407333e+05
Washington           Seattle              4.515000e+05  4.591667e+05
Maryland             Baltimore            1.095333e+05  1.073667e+05
Colorado             Denver               2.775000e+05  2.872333e+05
District of Columbia Washington           4.530000e+05  4.603000e+05
Tennessee            Nashville            1.623000e+05  1.669000e+05
Wisconsin            Milwaukee            9.216667e+04  9.196667e+04
Arizona              Tucson               1.434333e+05  1.442333e+05
Oregon               Portland             2.872667e+05  2.955333e+05
Oklahoma             Oklahoma City        1.189667e+05  1.201000e+05
Nebraska             Omaha                1.303000e+05  1.325000e+05
New Mexico           Albuquerque          1.640000e+05  1.648000e+05
California           Fresno               1.736000e+05  1.781333e+05
...                                              ...           ...
Texas                Granite Shoals       1.175333e+05  1.175333e+05
Maryland             Piney Point          3.090000e+05  3.092333e+05
Wisconsin            Maribel              1.289667e+05  1.296333e+05
Idaho                Middleton            1.457000e+05  1.462333e+05
Colorado             Bennett              1.620667e+05  1.714000e+05
New Hampshire        East Hampstead       2.521000e+05  2.557333e+05
Missouri             Garden City          1.043000e+05  1.047667e+05
Arkansas             Mountainburg         8.506667e+04  8.846667e+04
Wisconsin            Oostburg             1.279333e+05  1.274333e+05
California           Twin Peaks           1.475333e+05  1.460667e+05
New York             Upper Brookville     1.749233e+06  1.729467e+06
Hawaii               Volcano              2.276333e+05  2.332000e+05
South Carolina       Wedgefield           7.026667e+04  7.206667e+04
Michigan             Williamston          1.689333e+05  1.708667e+05
Arkansas             Decatur              9.256667e+04  9.470000e+04
Tennessee            Briceville           5.423333e+04  5.260000e+04
Indiana              Edgewood             9.406667e+04  9.466667e+04
Tennessee            Palmyra              1.269333e+05  1.262333e+05
Maryland             Saint Inigoes        2.884333e+05  2.869667e+05
Indiana              Marysville           1.151000e+05  1.165000e+05
California           Forest Falls         1.675000e+05  1.771000e+05
Missouri             Bois D Arc           1.375667e+05  1.404000e+05
Virginia             Henrico              2.040000e+05  2.059000e+05
New Jersey           Diamond Beach        3.878667e+05  3.876667e+05
Tennessee            Gruetli Laager       5.636667e+04  5.713333e+04
Wisconsin            Town of Wrightstown  1.468667e+05  1.492333e+05
New York             Urbana               1.370333e+05  1.400667e+05
Wisconsin            New Denmark          1.811667e+05  1.861667e+05
California           Angels               2.540667e+05  2.599333e+05
Wisconsin            Holland              2.015667e+05  2.012667e+05

                                            2015q1        2015q2  \
State                RegionName
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New York	New York	5.322667e+05	5.408000e+05
California	Los Angeles	5.288000e+05	5.381667e+05
Illinois	Chicago	2.010667e+05	2.060333e+05
Pennsylvania	Philadelphia	1.162000e+05	1.179667e+05
Arizona	Phoenix	1.715333e+05	1.741667e+05
Nevada	Las Vegas	1.775000e+05	1.816000e+05
California	San Diego	5.033667e+05	5.120667e+05
Texas	Dallas	1.137000e+05	1.211333e+05
California	San Jose	7.314333e+05	7.567333e+05
Florida	Jacksonville	1.241667e+05	1.269000e+05
California	San Francisco	1.000733e+06	1.060800e+06
Texas	Austin	2.665000e+05	2.750333e+05
Michigan	Detroit	3.620000e+04	3.583333e+04
Ohio	Columbus	1.078667e+05	1.094333e+05
Tennessee	Memphis	7.053333e+04	6.870000e+04
North Carolina	Charlotte	1.551667e+05	1.579000e+05
Texas	El Paso	1.115000e+05	1.113000e+05
Massachusetts	Boston	4.485000e+05	4.553667e+05
Washington	Seattle	4.679333e+05	4.933667e+05
Maryland	Baltimore	1.080667e+05	1.114333e+05
Colorado	Denver	2.976333e+05	3.103667e+05
District of Columbia	Washington	4.661667e+05	4.810667e+05
Tennessee	Nashville	1.714667e+05	1.762667e+05
Wisconsin	Milwaukee	9.333333e+04	9.410000e+04
Arizona	Tucson	1.441667e+05	1.451333e+05
Oregon	Portland	3.019333e+05	3.119000e+05
Oklahoma	Oklahoma City	1.208000e+05	1.223667e+05
Nebraska	Omaha	1.330667e+05	1.344667e+05
New Mexico	Albuquerque	1.651667e+05	1.659000e+05
California	Fresno	1.804667e+05	1.820333e+05
...		...	...
Texas	Granite Shoals	1.171667e+05	1.191000e+05
Maryland	Piney Point	3.095667e+05	3.017000e+05
Wisconsin	Maribel	1.312667e+05	1.301333e+05
Idaho	Middleton	1.461667e+05	1.477333e+05
Colorado	Bennett	1.780333e+05	1.844333e+05
New Hampshire	East Hampstead	2.587333e+05	2.613667e+05
Missouri	Garden City	1.060333e+05	9.606667e+04
Arkansas	Mountainburg	8.903333e+04	8.556667e+04
Wisconsin	Oostburg	1.270667e+05	1.274000e+05
California	Twin Peaks	1.435000e+05	1.523000e+05
New York	Upper Brookville	1.749867e+06	1.789600e+06
Hawaii	Volcano	2.346333e+05	2.323667e+05
South Carolina	Wedgefield	7.570000e+04	7.206667e+04
Michigan	Williamston	1.744333e+05	1.758667e+05
Arkansas	Decatur	9.350000e+04	9.490000e+04
Tennessee	Briceville	4.963333e+04	4.590000e+04
Indiana	Edgewood	9.586667e+04	9.433333e+04

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Tennessee             Palmyra              1.223000e+05  1.204667e+05
Maryland              Saint Inigoes        2.847000e+05  2.807667e+05
Indiana               Marysville           1.118667e+05  1.118000e+05
California            Forest Falls         1.765333e+05  1.818000e+05
Missouri              Bois D Arc           1.450333e+05  1.475667e+05
Virginia              Henrico              2.065667e+05  2.104333e+05
New Jersey            Diamond Beach        3.931667e+05  3.980000e+05
Tennessee             Gruetli Laager       5.890000e+04  6.536667e+04
Wisconsin             Town of Wrightstown  1.486667e+05  1.493333e+05
New York              Urbana               1.417000e+05  1.378667e+05
Wisconsin             New Denmark          1.876000e+05  1.886667e+05
California            Angels               2.601000e+05  2.506333e+05
Wisconsin             Holland              2.060000e+05  2.076000e+05

                                                 2015q3        2015q4  \
State                 RegionName
New York              New York             5.572000e+05  5.728333e+05
California            Los Angeles          5.472667e+05  5.577333e+05
Illinois              Chicago              2.083000e+05  2.079000e+05
Pennsylvania          Philadelphia         1.212333e+05  1.222000e+05
Arizona               Phoenix              1.790667e+05  1.838333e+05
Nevada                Las Vegas            1.867667e+05  1.906333e+05
California            San Diego            5.197667e+05  5.254667e+05
Texas                 Dallas               1.285667e+05  1.346000e+05
California            San Jose             7.764000e+05  7.891333e+05
Florida               Jacksonville         1.301333e+05  1.320000e+05
California            San Francisco        1.095100e+06  1.105467e+06
Texas                 Austin               2.816333e+05  2.872333e+05
Michigan              Detroit              3.706667e+04  3.836667e+04
Ohio                  Columbus             1.115667e+05  1.150000e+05
Tennessee             Memphis              6.866667e+04  6.953333e+04
North Carolina        Charlotte            1.601667e+05  1.628667e+05
Texas                 El Paso              1.110667e+05  1.102667e+05
Massachusetts         Boston               4.639667e+05  4.716333e+05
Washington            Seattle              5.142667e+05  5.334667e+05
Maryland              Baltimore            1.139667e+05  1.139000e+05
Colorado              Denver               3.205000e+05  3.301000e+05
District of Columbia  Washington           4.934000e+05  5.009000e+05
Tennessee             Nashville            1.818000e+05  1.892000e+05
Wisconsin             Milwaukee            9.413333e+04  9.456667e+04
Arizona               Tucson               1.466000e+05  1.481667e+05
Oregon                Portland             3.257333e+05  3.430667e+05
Oklahoma              Oklahoma City        1.247000e+05  1.271000e+05
Nebraska              Omaha                1.367333e+05  1.400667e+05
New Mexico            Albuquerque          1.665333e+05  1.673333e+05
California            Fresno               1.857000e+05  1.874667e+05
...                                                 ...           ...
Texas                 Granite Shoals       1.216000e+05  1.280000e+05
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Maryland	Piney Point	3.052333e+05	3.099667e+05
Wisconsin	Maribel	1.297333e+05	1.293000e+05
Idaho	Middleton	1.482000e+05	1.511333e+05
Colorado	Bennett	1.916667e+05	1.958000e+05
New Hampshire	East Hampstead	2.616000e+05	2.688000e+05
Missouri	Garden City	9.930000e+04	1.034333e+05
Arkansas	Mountainburg	8.370000e+04	9.043333e+04
Wisconsin	Oostburg	1.303333e+05	1.320333e+05
California	Twin Peaks	1.552667e+05	1.591667e+05
New York	Upper Brookville	1.777267e+06	1.834367e+06
Hawaii	Volcano	2.249667e+05	2.324333e+05
South Carolina	Wedgefield	7.033333e+04	6.903333e+04
Michigan	Williamston	1.794667e+05	1.823000e+05
Arkansas	Decatur	9.543333e+04	9.700000e+04
Tennessee	Briceville	4.793333e+04	4.360000e+04
Indiana	Edgewood	9.663333e+04	9.996667e+04
Tennessee	Palmyra	1.198000e+05	1.258000e+05
Maryland	Saint Inigoes	2.778333e+05	2.768333e+05
Indiana	Marysville	1.156667e+05	1.201667e+05
California	Forest Falls	1.911667e+05	1.987333e+05
Missouri	Bois D Arc	1.463000e+05	1.494333e+05
Virginia	Henrico	2.121000e+05	2.139667e+05
New Jersey	Diamond Beach	3.992333e+05	4.004333e+05
Tennessee	Gruetli Laager	6.950000e+04	7.170000e+04
Wisconsin	Town of Wrightstown	1.498667e+05	1.499333e+05
New York	Urbana	1.364667e+05	1.361667e+05
Wisconsin	New Denmark	1.884333e+05	1.889333e+05
California	Angels	2.635000e+05	2.795000e+05
Wisconsin	Holland	2.128667e+05	2.178333e+05

		2016q1	2016q2	\
State	RegionName			
New York	New York	5.828667e+05	5.916333e+05	
California	Los Angeles	5.660333e+05	5.774667e+05	
Illinois	Chicago	2.060667e+05	2.082000e+05	
Pennsylvania	Philadelphia	1.234333e+05	1.269333e+05	
Arizona	Phoenix	1.879000e+05	1.914333e+05	
Nevada	Las Vegas	1.946000e+05	1.972000e+05	
California	San Diego	5.293333e+05	5.362333e+05	
Texas	Dallas	1.405000e+05	1.446000e+05	
California	San Jose	8.036000e+05	8.189333e+05	
Florida	Jacksonville	1.339667e+05	1.372000e+05	
California	San Francisco	1.121767e+06	1.119267e+06	
Texas	Austin	2.935000e+05	3.014333e+05	
Michigan	Detroit	3.796667e+04	3.746667e+04	
Ohio	Columbus	1.167000e+05	1.182000e+05	
Tennessee	Memphis	7.090000e+04	7.416667e+04	
North Carolina	Charlotte	1.664667e+05	1.694333e+05	

Texas	El Paso	1.106667e+05	1.114667e+05
Massachusetts	Boston	4.826000e+05	4.903667e+05
Washington	Seattle	5.517333e+05	5.755333e+05
Maryland	Baltimore	1.146667e+05	1.147333e+05
Colorado	Denver	3.355667e+05	3.427667e+05
District of Columbia	Washington	5.041000e+05	5.058000e+05
Tennessee	Nashville	1.950667e+05	2.003667e+05
Wisconsin	Milwaukee	9.466667e+04	9.636667e+04
Arizona	Tucson	1.495333e+05	1.511667e+05
Oregon	Portland	3.560000e+05	3.698000e+05
Oklahoma	Oklahoma City	1.279000e+05	1.293000e+05
Nebraska	Omaha	1.416333e+05	1.426667e+05
New Mexico	Albuquerque	1.691000e+05	1.706333e+05
California	Fresno	1.890333e+05	1.927333e+05
...		...	...
Texas	Granite Shoals	1.337667e+05	1.400667e+05
Maryland	Piney Point	3.195000e+05	3.241667e+05
Wisconsin	Maribel	1.278333e+05	1.292667e+05
Idaho	Middleton	1.539000e+05	1.571667e+05
Colorado	Bennett	1.997667e+05	2.074667e+05
New Hampshire	East Hampstead	2.725333e+05	2.778000e+05
Missouri	Garden City	1.062667e+05	1.116667e+05
Arkansas	Mountainburg	9.833333e+04	1.019000e+05
Wisconsin	Oostburg	1.327667e+05	1.341000e+05
California	Twin Peaks	1.641667e+05	1.679667e+05
New York	Upper Brookville	1.904500e+06	1.944067e+06
Hawaii	Volcano	2.420667e+05	2.489667e+05
South Carolina	Wedgefield	6.886667e+04	7.426667e+04
Michigan	Williamston	1.814667e+05	1.824000e+05
Arkansas	Decatur	9.650000e+04	9.663333e+04
Tennessee	Briceville	4.080000e+04	4.180000e+04
Indiana	Edgewood	9.943333e+04	9.996667e+04
Tennessee	Palmyra	1.276667e+05	1.328667e+05
Maryland	Saint Inigoes	2.793333e+05	2.826333e+05
Indiana	Marysville	1.282333e+05	1.232333e+05
California	Forest Falls	1.886333e+05	1.898667e+05
Missouri	Bois D Arc	1.468667e+05	1.437667e+05
Virginia	Henrico	2.160333e+05	2.162000e+05
New Jersey	Diamond Beach	4.045333e+05	4.039000e+05
Tennessee	Gruetli Laager	7.533333e+04	7.646667e+04
Wisconsin	Town of Wrightstown	1.498333e+05	1.512667e+05
New York	Urbana	1.389667e+05	1.442000e+05
Wisconsin	New Denmark	1.910667e+05	1.928333e+05
California	Angels	2.765333e+05	2.716000e+05
Wisconsin	Holland	2.219667e+05	2.280333e+05

		2016q3
State	RegionName	

New York	New York	5.872000e+05
California	Los Angeles	4.409222e+05
Illinois	Chicago	1.778222e+05
Pennsylvania	Philadelphia	1.024111e+05
Arizona	Phoenix	1.593667e+05
Nevada	Las Vegas	1.736222e+05
California	San Diego	4.134111e+05
Texas	Dallas	1.493000e+05
California	San Jose	6.231111e+05
Florida	Jacksonville	1.189889e+05
California	San Francisco	8.253889e+05
Texas	Austin	3.044500e+05
Michigan	Detroit	3.790000e+04
Ohio	Columbus	1.078000e+05
Tennessee	Memphis	7.080000e+04
North Carolina	Charlotte	1.466111e+05
Texas	El Paso	9.737778e+04
Massachusetts	Boston	3.754667e+05
Washington	Seattle	4.477889e+05
Maryland	Baltimore	9.471111e+04
Colorado	Denver	2.674222e+05
District of Columbia	Washington	5.162500e+05
Tennessee	Nashville	1.653667e+05
Wisconsin	Milwaukee	8.860000e+04
Arizona	Tucson	1.323111e+05
Oregon	Portland	2.987333e+05
Oklahoma	Oklahoma City	1.086444e+05
Nebraska	Omaha	1.255111e+05
New Mexico	Albuquerque	1.531556e+05
California	Fresno	1.610778e+05
...		...
Texas	Granite Shoals	1.464500e+05
Maryland	Piney Point	2.668778e+05
Wisconsin	Maribel	1.342000e+05
Idaho	Middleton	1.415667e+05
Colorado	Bennett	1.702667e+05
New Hampshire	East Hampstead	2.312222e+05
Missouri	Garden City	1.136000e+05
Arkansas	Mountainburg	8.743333e+04
Wisconsin	Oostburg	1.192333e+05
California	Twin Peaks	1.440333e+05
New York	Upper Brookville	1.610589e+06
Hawaii	Volcano	2.014111e+05
South Carolina	Wedgefield	8.070000e+04
Michigan	Williamston	1.635444e+05
Arkansas	Decatur	8.288889e+04
Tennessee	Briceville	3.958889e+04
Indiana	Edgewood	1.009500e+05

```
Tennessee            Palmyra              1.377500e+05
Maryland             Saint Inigoes        2.333556e+05
Indiana              Marysville           1.242000e+05
California           Forest Falls         1.495556e+05
Missouri             Bois D Arc           1.218778e+05
Virginia             Henrico              1.836111e+05
New Jersey           Diamond Beach        3.115889e+05
Tennessee            Gruetli Laager       5.984444e+04
Wisconsin            Town of Wrightstown  1.550000e+05
New York             Urbana               1.173556e+05
Wisconsin            New Denmark          1.976000e+05
California           Angels               2.188556e+05
Wisconsin            Holland              2.000111e+05

[10730 rows x 67 columns]
```

In [18]:
```
def run_ttest():
    '''First creates new data showing the decline or growth of housing prices
    between the recession start and the recession bottom. Then runs a ttest
    comparing the university town values to the non-university towns values,
    return whether the alternative hypothesis (that the two groups are the same)
    is true or not as well as the p-value of the confidence.

    Return the tuple (different, p, better) where different=True if the t-test is
    True at a p<0.01 (we reject the null hypothesis), or different=False if
    otherwise (we cannot reject the null hypothesis). The variable p should
    be equal to the exact p value returned from scipy.stats.ttest_ind(). The
    value for better should be either "university town" or "non-university town"
    depending on which has a lower mean price ratio (which is equivilent to a
    reduced market loss).'''
    start=get_recession_start()
    bottom=get_recession_bottom()
    housing=convert_housing_data_to_quarters().dropna()

    housing['Ratio']= (housing[start]/housing[bottom])

    uni_towns=get_list_of_university_towns()
    housing=housing.reset_index('RegionName')
    uni_check=lambda x: "Yes" if x in uni_towns['RegionName'].tolist() else "No"
    housing['Uni Town']= housing['RegionName'].apply(uni_check)

    ut= housing[housing['Uni Town']=='Yes']
    nut= housing[housing['Uni Town']=='No']

    t,p = ttest_ind(ut['Ratio'].dropna(),nut['Ratio'].dropna())

    different = True if p < 0.01 else False
```

```
        better = "university town" if ut['Ratio'].mean() < nut['Ratio'].mean() else "non-un
        return different,p,better

    run_ttest()
```

Out[18]: (True, 0.00032605039167563337, 'university town')

In [ ]:

In [ ]: